FRD Activities Report
August 2001

Research Programs

Hurricane Balloon

Work on the Smart Hurricane Balloon has focused on three areas. The first was designed to address concerns about the reliability of the balloon's self cut down mechanism under differing failures modes. To test this, we constructed a simulator for the balloon payload that could repeatedly simulate various failure modes and monitor the response of the balloon. Tests using the simulator are currently underway and initial results show 100 percent reliability of all the systems.

Figure 1. Eric Egan and Shane Beard holding aloft a Smart Hurricane Balloon.

The second area of work focused on communications. The system was set up with the base computer and the balloon payload communicating via the satellite telephone for the first time. Software bugs had to be worked out for correct modem interface. The system works well now and will be undergoing complete testing over the next few weeks.

The third area focused on compliance with NOAA's Aircraft Operations Center and Air Force requirements for simultaneous smart balloon flights with research aircraft in a hurricane. The new August 22 mandated changes are based on the concern that the balloon has no horizontal position control and that altitude control has not been proven in severe storm conditions. Therefore, separation between the balloon and research aircraft cannot be guaranteed at all times. Additional testing to verify performance of our balloon in a storm environment will be carried out. The additional testing will:

- Insure the cut down valve brings the balloon down in the event of a power failure or loss of communications.
- Provide test data verifying all modes of failure including loss of communications, operator commanded, processor failure, power failure, and end of test timeout failure.
- Reduce the communication failure cut down time from its present fifteen minutes to possibly as little as two.
- Add and test a feature to cut down the balloon if it reaches or exceeds a predetermined maximum altitude.
- Gather actual flight test data to verify altitude control and positive

communications in a storm environment.

- Gather information on failure data on critical components in the balloon cut down system.

Progress on these new requirements includes:

- The original normally closed cut valve was replaced with a normally open valve. The valve solid state switch inside the transponder has been modified to operate with the new release valve. The change causes the balloon to be brought down if power fails, the valve connector comes loose, the valve fails, a wire in the valve wiring harness breaks, or the battery voltage gets too low.
- A test simulator has been designed and built to allow testing of all failure modes. The simulator also tests GPS failure and maximum altitude cut down.
- Tests show reducing the communications failure cut down time to 2 minutes will frequently destroy the balloon. This is because, every 1 to 2 hours, communication must disconnect to switch between gateways. Such gateway changes often require more than two minutes. A 5 minutes communications failure cut down time would help eliminate unnecessary termination of a balloon experiment. We will suggest that only when a aircraft is near should a 2 minute cut down be used.
- The software has been modified to have the balloon cut down at a predetermined maximum altitude.
- When all of the testing is complete and everyone is satisfied with the results the balloon will be tested under actual flight conditions and the resulting data will be forwarded for acceptance.

(Randy.Johnson@noaa.gov, Roger Carter, Shane Beard)

CBLAST-Low

The Coupled Boundary Layer Air-Sea Transfer light wind (CBLAST-Low) pilot study was conducted over a three-week period off the south coast of Martha's Vineyard, Massachusetts. The LongEZ research aircraft (Figure 2 and Table 1) flew 20 missions for a total of about 52 hours. The objective of CBLAST-Low is to examine air-sea transfer processes under very light wind (< 3 m s^{-1}) regimes. These processes are not well understood and are inadequately modeled.

Figure 2. The LongEZ landing at Martha's Vineyard airport after a CBLAST-Low mission.

Table 1. LongEZ flight summary

FL	Date	Start/End Time (UTC)		FL Hr	Comments
1	21 JUL 01	12:58:29	16:29:01	3.4	north-south flux legs, radar calibrations
2	22 JUL 01	10:04:45	11:27:42	1.4	SAR intercomparison
3	23 JUL 01	16:50:15	19:13:14	2.4	north-south flux legs, radar calibrations
4	25 JUL 01	16:54:11	18:52:47	2.0	north-south flux legs, IR camera runs
5	27 JUL 01	12:31:32	16:32:30	4.0	north-south flux legs, IR camera runs
6	27 JUL 01	22:37:34	23:14:03	0.7	"mowing the lawn" IR camera runs
7	28 JUL 01	11:02:21	13:59:25	3.0	multi-directional flux legs, IR camera runs
8	29 JUL 01	09:31:22	10:18:13	1.5	sunrise IR camera runs
9	29 JUL 01	11:43:54	13:46:36	2.0	"spirograph" flux legs
10	30 JUL 01	11:43:48	15:10:56	3.5	"bow tie" flux legs, IR camera runs, wind calibrations
11	31 JUL 01	09:29:00	11:52:59	2.4	"bow tie" flux legs, "mowing the lawn" IR camera runs
12	01 AUG 01	09:40:09	12:54:59	3.3	SAR intercomparison, IR camera runs, "spirograph" flux legs
13	01 AUG 01	16:54:29	19:40:33	2.8	"bow tie" flux legs over R/V *Asterias*, "spirograph" flux legs
14	02 AUG 01	14:47:23	17:12:35	2.4	"spirograph" flux legs, IR camera runs
15	03 AUG 01	00:58:21	02:22:29	1.9	nighttime "mowing the lawn" IR camera runs
16	05 AUG 01	15:51:03	16:30:35	0.7	flight terminated due to heavy fog and poor visibility
17	05 AUG 01	20:11:12	20:55:25	0.8	flight terminated due to heavy fog and poor visibility
18	07 AUG 01	13:29:19	17:32:00	4.1	"spirograph" and "bow tie" flux legs
19	08 AUG 01	10:03:04	14:01:50	4.0	SAR intercomparison, "spirograph" and "bow tie" flux legs
20	08 AUG 01	15:37:21	17:06:37	1.5	"bow tie" flux legs over R/V *Asterias*

The LongEZ, data acquisition system, and all of the instruments performed exceptionally well during CBLAST-Low. The greatest challenge during the field study was heavy fog and/or poor visibility. Stagnation of a Bermuda high pressure system during the last week of the study with a weak but stable southwesterly flow established a very humid marine atmospheric boundary layer (MABL) with substantial haze. While these conditions are "ideal" for meeting the objectives of CBLAST-Low, the LongEZ did not fly when these unsafe flying conditions existed. Nevertheless, enough flights were flown under light wind conditions in which the MABL was stable, near neutral, and unstable.

Contour plots of sea surface temperature (Figure 3) and air temperature (Figure 4) were constructed from a so-called "spirograph" pattern flown by the LongEZ. In this particular case,

data were acquired on 29 July 2001. The region was dominated by a high pressure system with mid- and high-level clouds moving into the area. Winds were very light and variable during this flight that was flown between 0800 and 0900 local time. The LongEZ flew 10-m high flux legs about 20 km in length with the center of the pattern over the air-sea interaction meteorology (ASIMET) buoy deployed by Bob Weller of the Woods Hole Oceanographic Institution. Note that the ASIMET buoy is located along the edge of a SST front with warmer water to the southwest and west of the buoy. SST temperature differences of 2° to 3° C were observed over the course of just a few kilometers. As expected, air temperature at 10 m reflects the forcing by the SST front with warmer air to the southwest and west and colder air to the northeast of this sample region. Differences of up to 2° C in air temperature were observed in this case study.

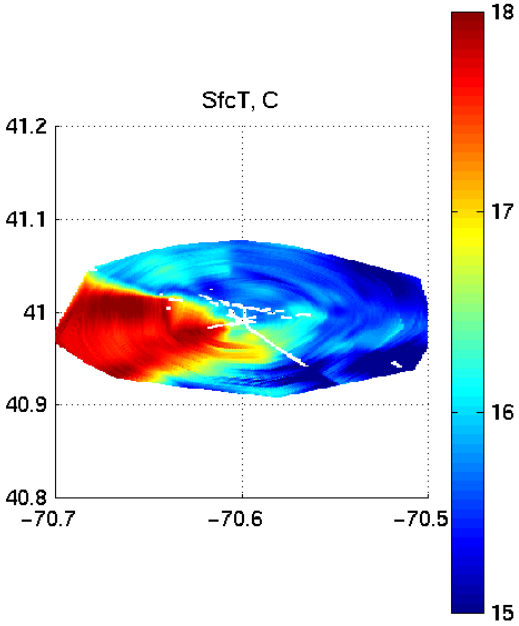

Figure 3. Sea surface temperature on 29 JUL 01 centered over ASIMET buoy.

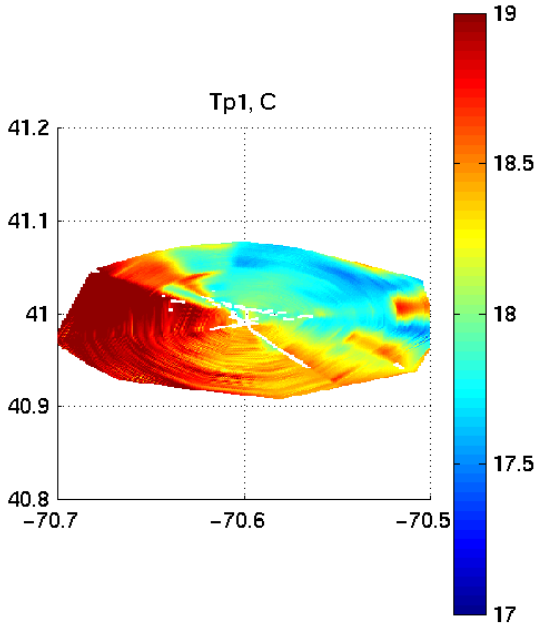

Figure 4. Air temperature on 29 JUL 01 centered over ASIMET buoy.

Many of the research flights were centered over the ASIMET buoy. However, the LongEZ flew over several other surface-based "assets" over the course of the three-week study. For several days during the first week, a "3-D" sea surface temperature net was deployed by WHOI about 15 km off shore. This grid or array was comprised of small solid state temperature sensors hung at and below the surface. This 100-m x 100-m array was moored at the corners. Horizontal separation of the SST sensors was approximately 10 m. This remarkable array was used to acquire SST in a volume and its changes over time. The LongEZ flew several missions over the 3-D in for intercomparisons. Another asset was the R/V *Asterias*

Figure 5. R/V *Asterias* and catamaran acquiring meteorological and oceanographic data during CBLAST-Low.

(Figure 5) which sailed several times over the course of the study. A full suite of surface-based turbulence sensors was deployed on the R/V *Asterias* as well as a catamaran being towed by the ship. When the ship was sailing, the LongEZ conducted numerous flux legs over the ship in order to document spatial variability of turbulence in the MABL. (Jerry.Crescenti@noaa.gov, Jeff French, and Tim Crawford)

CASES-99

Significant progress was made in processing the Long-EZ CASES-99 data during August. Improved differential corrections were obtained for the GPS positions and velocities using the flykin program. Work is now under way to correct several timing errors that have been observed in the CASES-99 data..

Improvements were also made to the method used to process the IRGA water-vapor measurements. The IRGA has a nonlinear response to water vapor. This is not a serious problem by itself, but the instrument also suffers from baseline drift. The combination of the nonlinear response and the baseline drift makes treatment of the IRGA data more difficult than many of the other instruments. The improved treatment of the IRGA data is based on the dew-point measurements from a chilled mirror, which is part of the Long-EZ's standard instrument package. This chilled mirror has a relatively slow response, but it does not suffer from baseline drift. Humidity measurements from the chilled mirror can therefore be used to quantify the baseline drift in the IRGA measurements. In the current software, the chilled mirror measurements are low-pass filtered using a cutoff at 1/60 Hz. Corrections for the IRGA measurements are then based on these filtered data. (Richard.Eckman@noaa.gov)

GAUNTLET 2001

A final report on FRD's contribution to the AFTAC GAUNTLET Program at Dugway, Utah, in April of this year has been completed. The project consisted of constructing a mobile SF_6 release mechanism capable of releasing gaseous SF_6 at a rate of 70 kg hr^{-1} for four hours. The release mechanism and three mobile real-time SF_6 analyzers in SUV's were deployed to Dugway where seven tracer tests were conducted in both daytime and nocturnal conditions. These tests involved eight FRD personnel on TDY to Dugway, and one additional person using the Internet for the first time for data processing at the FRD office instead of in the field. Careful quality control checks in the field and during data processing the day following each test at the FRD office, together with new more stringent in-field calibration checks, prevented the collection of any unusable data. A total of 246 plume traverses were completed by the real-time SF_6 analyzers. The report summarizes the results of these traverses and is currently undergoing internal FRD review. (Kirk.Clawson@noaa.gov and staff)

Cooperative Research with INEEL

INEEL Mesonet

At the request of DOE, we are adding two community monitoring stations, located at the middle schools in Rexburg and Blackfoot, to the INEEL Mesoscale Meteorological Network (mesonet).

These stations will eventually replace current stations located near these cities, but we will collect wind, temperature, and humidity data from both the old stations and the community monitoring stations for one year to help document differences between the old and new sites. We have replaced the data acquisition and communication equipment at these two sites so they are compatible with the mesonet and have made the necessary software modifications so that data may be collected from the new sites. The process of moving instrumentation from the old sites to the community monitoring sites is also underway. (Roger.Carter@noaa.gov, Randy Johnson, Tom Strong, Kirk Clawson)

INEEL Mesoscale Modeling

As was first discussed in the July activity report, the dual-processor Alpha workstation used for running MM5 forecasts developed serious hardware problems at the end of July. Parts were shipped back and forth with the workstation's manufacturer, Aspen Systems, for much of August before the problems were corrected. One of the problems was related to a CPU fan not working properly. The BIOS used on the workstation checks the state of the CPU fans and will not boot up unless the fans are working properly. Unfortunately, the system gives no diagnostic messages when it detects a problem with the fans. A second problem was that one of the 9 Mb hard disks failed. Aspen Systems sent a replacement disk later in August. The hardware is now working properly, but it will likely be sometime in September before the MM5 forecasts are up and running. (Richard.Eckman@noaa.gov)

Safety Tour

Debbie Lacroix and Kirk Clawson participated in a safety tour of several INEEL facilities on August 22. The tour was sponsored by the Rocky Mountain Federal Safety and Health Council. Membership includes any safety officer in any federal facility within a 75 mile radius of Idaho Falls. The tour included a lecture from the Chairman of the INEEL maintenance and operations contractor (BBWI) Employee Safety about overall worker safety, a tour of the Idaho Nuclear Technology and Engineering Center to observe safety systems in place to protect worker, the environment and the public, a tour of Fleet Operations Big Shop to observe garage and fleet safety operations, a tour of the INEEL Institute to learn about safety training programs in already in place, and finally a tour of the new Fire House and Fire Training Center. The day was well spent learning about safety procedures in place at the INEEL and how they might apply to FRD. Perhaps the most useful was the discussion with the INEEL Institute on available safety training for FRD personnel and the offer to lend free of charge any videos in their possession for viewing in the FRD seminar room. (Debbie.Lacroix@noaa.gov and Kirk Clawson)

Other Activities

Outreach Lecture at Martha's Vineyard

Tim Crawford and Jerry Crescenti gave an informal talk to the Martha's Vineyard Chapter1215 of the Experiment Aircraft Association (EAA) on the evening of August 1, 2001 (Fig 6.). The unique capabilities of the LongEZ and how it was being utilized in the CBLAST-Low field study were discussed. A strong emphasis was placed on both science and flight safety. About 40 chapter members were in attendance. The LongEZ generated much interest among the EAA chapter members as well as many members of the general public. (Tim.Crawford@noaa.gov, Jerry Crescenti)

Fig 6. Tim Crawford giving a talk about the LongEZ to EAA Chapter 1215.

Papers

Allwine, K. J., J. H. Shinn, G. E. Streit, K. L. Clawson, and M. Brown, 2002: An overview of URBAN 2000: a multi-scale field study of dispersion through an urban environment. *Bull. Amer. Meteorol. Soc., submitted*.

Clawson, K. L, R. G. Carter, B. R. Reese, R. C. Johnson, N. F. Hukari, and D. Lacroix. 2001. GAUNTLET SF_6 Atmospheric Tracer Release and Field Test Support. NOAA Technical Memorandum OAR ARL, Silver Spring, MD, *in review*.

Travel

Jerry Crescenti and Tim Crawford continued in travel status during their participation in the CBLAST-Low Pilot Field Study at Martha's Vineyard, Massachussetts, until August 10 when the field measurement phase of the study was completed and they returned to Idaho.

Training

Kirk Clawson attended a two-day workshop on challenges facing a team leader and how to develop the skills necessary to be an effective team leader. The workshop was held in Idaho Falls on August 13-14.

Visitors

Simon Chang, Program Officer for the Office of Naval Research, visited Jerry Crescenti and Tim Crawford in Martha's Vineyard, Massachusetts on August 6 to learn more about LongEZ research operations in the CBLAST-Low Pilot Field Study.

Margaret Mccalla, the Acting Director of the NOAA Office of Policy and Strategic Planning, visited FRD on August 7. She received a tour of the facilities and briefings on division programs. Tom Watson described his work on a 2004 budget initiative to measure CO_2 fluxes from aircraft. Information on the DOE support activities, mesonet, and modeling and emergency response activities was given by Kirk Clawson. Roger Carter and Debbie Lacroix described the use of tracers in atmospheric diffusion and dispersion field programs. Randy Johnson discussed his work in the development and use of Smart Balloons in atmospheric research. The use of the Long-EZ to measure flux, turbulence, and air sea processes was presented by Jeff French.. Rick Eckmann described modeling and forecasting in support of the DOE. Lastly, Paula Fee discussed the FRD budget and the NOAA overhead issues.